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March 20, 2015

VIA: Electronic Mail

U.S. Environmental Protection Agency
Region VII SUPR/MOKS
11201 Renner Boulevard
Lenexa, KS 66219

ATTENTION: Mr. Bradley Vann

SUBJECT: Phase 1D Investigation – Additional Characterization of Extent of Radiologically-Impacted Material in Area 1: Addendum to Phase 1 Work Plans for Isolation Barrier Investigation, West Lake Landfill Operable Unit-1, Bridgeton, Missouri

Dear Mr. Vann,

On behalf of Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC., Rock Road Industries, Inc., and the United States Department of Energy (the "Respondents"), Engineering Management Support Inc. (EMSI) submits this letter as an Addendum to the Phase 1 Investigation Work Plans and is intended to describe the scope and procedures to be used to conduct additional investigation of the extent of radiologically-impacted material (RIM) associated with Area 1 at the West Lake Landfill. This letter is considered to be Addendum No. 1 to the Gamma Cone Penetration Test (GCPT) Work Plan Revision 2 dated September 27, 2013 and Addendum No. 3 to the Core Sampling (Phase 1B, 1C and 2) Work Plan – Revision 1 dated January 8, 2014 and prior related Addendums No. 1 dated February 11, 2014 and No. 2 dated February 27, 2014, all of which were prepared by Feezor Engineering, Inc. and others and previously approved by the U.S. Environmental Protection Agency Region VII (EPA).¹ This work plan addendum is being submitted in response to the request made in EPA's January 15, 2015 letter to the Respondents and in accordance with the West Lake Landfill Administrative Order on Consent, Docket No. VII-93-F-005.

Scope of Work and Objectives of the Investigation

Based on discussions that occurred during a technical meeting at EPA's offices on January 23, 2014, fourteen (14) additional borings will be drilled along the western and southwestern margins of Area 1. The proposed boring locations are shown on Figure 1

¹ Cotter was not part of the initial Phase 1 work and did not review or comment on the prior Phase 1 report before it was submitted to EPA.

attached to this letter; however, the locations are subject to adjustment in the field to account for physical access constraints, presence of infrastructure and utilities, and any construction or maintenance activities associated with the Bridgeton Landfill that may occur contemporaneously with the drilling of these borings. The anticipated depths of the borings are provided on Table 1.

These borings are intended to augment the results obtained from the previously completed Phase 1 work (which included Phases 1A, 1B and 1C), the results of which were presented in the December 2014 report prepared by Feezor Engineering, Inc. and others (Feezor Engineering, Inc., et al., 2014a), and the results of all of the earlier investigations of OU-1 (EMSI, 2000, McLaren Hart 1996a and 1996b, NRC, 1988 and RMC, 1982). The 14 additional borings and associated work are being termed Phase 1D to differentiate this work from the previously completed work.

The goal of the Phase 1D investigation is to complete the investigation of the extent of RIM along the southern and western boundaries of Area 1. To that end, results of the field investigations (e.g., GCPT field gamma readings, Sonic core samples, downhole gamma scans of the Sonic borings, etc.) will be reviewed in the field as they are developed to assess the potential for occurrence of RIM (based on gamma emissions from radium) at each location to allow for field decisions, in consultation with EPA, regarding the possible need for additional borings or for deletion or relocation of one or more of the proposed borings. Final determination of the extent of RIM will be based on review and evaluation of the results of all of the Phase 1D field investigation activities and laboratory analyses to account for possible thorium occurrences which cannot be readily detected by the gamma scans and for gamma emissions from potassium-40 which are unrelated to possible RIM occurrences.

It is anticipated that drilling, logging, sampling and analytical testing of soil/waste samples from these borings will define the outer extent of RIM associated with Area 1. The additional soil boring locations have been selected to provide an outer limit to the previously identified occurrences of RIM in the southern and western portions of Area 1 when the results of the Phase 1D investigation are incorporated with historical information regarding the extent of refuse associated with Area 1 and its relationship to other site features (e.g., areas where no refuse exists and the boundaries of other solid waste management units at the Site).

It is expected that the results of the Phase 1D investigation, when combined with the results of the prior Phase 1 investigation, the earlier Remedial Investigation (RI) and the pre-RI investigations conducted by the NRC, will provide sufficient additional information to complete the assessment of the extent of RIM along the southern and western boundaries of Area 1 to the degree needed to conduct additional evaluations of potential remedial alternatives for Area 1 as necessary and to select a potential location(s) for a possible isolation barrier within the southern portion of Area 1 or along the southern boundary of Area 1. To the extent that a potential location for a possible isolation barrier

is selected within the nominal extent of Area 1, the Phase 1D investigation results, combined with the results of the earlier studies, will provide sufficient data to allow for evaluation of potential short-term or long-term risks that may arise if a possible isolation barrier is located within, as opposed to completely outside, the extent of RIM.

Field Investigation and Sample Collection and Analyses

The sequence and overall scope of the additional investigations are anticipated to occur as follows:

1. The boring locations will be surveyed and staked in the field and on-site personnel familiar with the locations of any underground utilities or infrastructure will inspect the locations to verify the absence of utilities or infrastructure. The locations will also be inspected for possible impacts to or from ongoing operations and maintenance construction associated with the Bridgeton Landfill. The proposed drilling locations will be adjusted if necessary prior to the start of drilling activities.
2. It is anticipated that a gamma cone penetrometer test (GCPT) rig will initially perform a direct push investigation utilizing a gamma detector to characterize the subsurface conditions to the limits of the depth of the GCPT equipment. It is expected that the equipment and procedures used to perform this work will be the same as those used to perform the prior Phase 1 work, as described in the September 2013 Phase 1 Work Plan and the December 2014 Phase 1 report, with the possible exception that a truck-mounted rig may be used in place of the track-mounted GCPT utilized for the earlier Phase 1 work. The goal of each boring will be to direct push through the solid waste materials into the underlying native materials to a depth of approximately 5 – 10 feet below the known or field estimated base of refuse to the extent that the equipment can do so as determined by the drilling contractor's operator. Continuous gamma readings will be obtained down the length of each boring as part of the direct push of the cone penetrometer. If refusal occurs before total depth is reached, a second boring may be driven next to the first boring depending upon the depth achieved by the first boring and the nature of the refusal condition. Field produced gamma reading results will be reviewed as they become available to allow for an early determination of the presence or absence of RIM (i.e., radium) at each location so that field decisions can be made, in consultation with EPA, regarding the possible need for additional boring locations or potential deletion or relocation of some of the planned boring locations. All GCPT borings including any abandoned GCPT borings that did not reach total depth will be grouted according to the procedures described in the previously approved Phase 1 GCPT work plan (Feezor Engineering, Inc., et al., 2013).

3. Upon completion of the GCPT borings, the results of the GCPT logs will be reviewed to identify any intervals with elevated gamma readings that may be reflective of the presence of RIM at each location and to identify target depths for collection of biased depth interval samples from those intervals with elevated gamma readings during the next step in the investigation.
4. Upon completion of the GCPT borings and review of the results, a Sonic drilling rig will be brought on site to drill soil borings and collect soil core samples from each location. It is anticipated that the Sonic drill rig will set up within 5 to 10 feet of the locations of the previously completed GCPT borings. The Sonic rig will drill down and collect continuous soil/waste samples (to the extent possible given actual core recoveries) through the solid waste materials and the upper approximately 5 to 10 feet of the underlying native materials. It is anticipated that the equipment and procedures used to perform this work will in general be the same as those used to perform the prior Phase 1 work, as described in the January 2014 Phase 1B, 1C and 2 Work Plan (Feezor Engineering, Inc., et al., 2014b), the related Addendum No. 1 dated February 11, 2014 (Feezor Engineering, Inc., et al., 2014c) and the December 2014 Phase 1 report (Feezor Engineering, Inc. et al., 2014a).
5. Upon completion of each Sonic borehole, the borehole will be downhole logged for gamma radiation. The collected core samples will be visually inspected (with color and appearance noted), geologically logged, and scanned for gamma radiation. Each of the soil borings will be grouted using a tremie pipe from the bottom of the hole up to the ground surface. The final, as-drilled locations for each boring will be surveyed.
6. Based on the results of the GCPT gamma logs, the downhole logging of the Sonic boreholes, and the visual and geologic logging and gamma scans of the core samples, samples will be selected from each boring for submittal to an offsite analytical laboratory for radioanalyses. Samples will be selected from the intervals with the highest gamma readings and/or at the discretion of the site health physicist/engineer/geologist from any intervals where visual inspection identifies potentially anomalous materials. For planning purposes, it is anticipated that two sample intervals will be selected from each boring for laboratory analyses. For borings with only one small interval (e.g., a foot or less) with elevated gamma readings, the second sample will be selected randomly; however, in this case preference will be given to the extent practical to obtaining samples from intervals bounded by the 1971 and 1975 topographic surfaces so as to maximize the potential for obtaining materials representative of wastes disposed contemporaneously with the placement of soil mixed with leached barium sulfate residue that occurred during the latter part of 1973. For borings that are drilled outside of the extent of the 1971 – 1975 waste deposits, that do not display any identifiable elevated gamma

levels, samples will be collected from two random depth intervals. EPA will be provided an opportunity to collect split samples for performance of duplicate sample analyses, toxicity leaching characteristics procedure (TCLP) testing, pyrolysis testing or whatever additional testing EPA desires to conduct, subject to the availability of sufficient material from the core intervals of interest. Priority will be given to obtaining sufficient sample volumes for the samples to be sent to the offsite laboratory for the additional characterization of Area 1 prior to collection of possible split samples.

7. The samples from the intervals selected for laboratory analyses will be double-bagged and placed in coolers provided by the laboratory and shipped to the Eberline Analytical facility in Oak Ridge, Tennessee for laboratory analyses. The samples will be dried and ground to promote homogeneity and analyzed for Radium-226, Radium-228, Thorium-230 and Thorium-232 and Uranium-234, Uranium-235 and Uranium-238. The samples will also be analyzed for Potassium-40 to allow for evaluation of possible contributions to the gamma readings from municipal solid waste (MSW) materials as opposed to RIM.
8. Upon receipt of the laboratory analytical reports and electronic data deliverables, the data will be subjected to data validation in general accordance with the procedures set forth in the Multi-Agency Radiation Laboratory Analytical Protocol (MARLAP) and entered into an electronic database with the appropriate data validation qualifiers.

Other than the changes described above, it is anticipated that all of the work will be performed in general accordance with the procedures set forth in the Phase 1 Work Plans (Feezor Engineering, Inc., 2014a, b, and c and 2013) and associated documents (e.g., Health and Safety Plans) used for the prior Phase 1 investigations.

Reporting

The progress of the field work and laboratory analyses will be reported as part of the monthly progress reports for OU-1. The as-received, unvalidated results of the laboratory analyses of the samples will be included in the monthly progress reports.

Upon receipt of all of the laboratory analytical results, the results will be subjected to data validation and entered into an electronic database as described above. A report of the results of the Phase 1D investigation will be prepared documenting the results of the field investigations and the laboratory analyses. The report will also include a preliminary assessment of the extent of RIM in Area 1 of the West Lake Landfill and the relationship between such RIM and adjacent solid waste units (e.g., the North Quarry portion of the Bridgeton Landfill) at the site. Differentiation of RIM from other possible occurrences of radionuclides in municipal solid waste (MSW) is expected to be made based on the locations and depths in which RIM is encountered relative to the 1971 and 1975

topographic elevations and the ratios of the activity levels of the radium (Ra-226/Ra-228) and thorium (Th-230/Th-232) isotopes. A final evaluation of the extent of RIM will be performed using the same procedures that were used in the Supplemental Feasibility Study (SFS) as part of preparation of the Supplemental SFS report.

In addition to a narrative description of the field investigation, summary of the field investigation results and laboratory analyses, and updated evaluation of the extent of RIM, the report is anticipated to also include the following information:

- Copies of the daily field logs,
- GCPT cone penetrometer and gamma logs,
- Downhole gamma scans of the Sonic boreholes,
- Final soil core geologic logs,
- Gamma scans of the soil cores,
- Photographs of the core samples,
- Chain-of-custody records,
- Analytical laboratory reports,
- Data validation reports,
- Worker and work area related health and safety air monitoring results,
- Equipment release survey results,
- Investigative derived waste volumes and test results, and
- General photographs of the field investigation activities if any are obtained.

Schedule

It is anticipated that the Phase 1D investigation will require approximately six months to complete from the date of EPA approval of this Work Plan Addendum. The schedule for the primary activities associated with the Phase 1D work is as follows:

| <u>Activity</u> | <u>Duration (weeks)</u> |
|--|-------------------------|
| Mobilization | 1 |
| Construction of access paths/drilling pads | 2 |
| GCPT borings | 2 |
| Sonic drilling, geologic logging and core scanning | 4 |
| Laboratory Analyses | 6 |
| Data validation/data management | 3 |
| Data evaluation/preparation of boring logs, summary tables and figures | 4 |
| Preparation and review of investigation report | 4 |
| Total Duration | 26 |

The above schedule is estimated and subject to change based on the actual levels of effort required for each task, the availability of the drilling subcontractors and their equipment,

and potential impacts from adverse weather conditions (e.g., day time high temperatures less than 25° F, thunderstorms, high winds, or other violent weather conditions, etc. that would necessitate work stoppages or delays). In the event that it is determined that a percussion drilling rig is required to complete the borings (as was necessary for some of the Phase 1C borings) additional time will be required to complete the work.

Project Team

EMSI will provide overall management and direction of the field investigation, data validation and management, data evaluation, and reporting. Feezor Engineering, Inc. will be responsible for the field investigations including all drilling, geologic logging of boreholes and core samples, and job site health and safety. Auxier & Associates will be responsible for performing the gamma logging of the core samples, and in conjunction with Feezor Engineering's geologist/engineer selecting sample intervals for submission to the radiochemistry laboratory, conducting downhole logging of the Sonic boreholes, if needed, monitoring and documentation of radiological conditions in and around the work area, scanning for and providing assistance to Feezor Engineering with implementation and monitoring of health and safety practices and scanning for equipment release. The GCPT logs will be provided to P.J. Carey & Associates for interpretation of geotechnical properties relative to possible future construction of an isolation barrier in the areas of the new boring locations; however, interpretation of the cone penetrometer data will not be included in the report of the Phase 1D investigation which instead will rely on the geologic logging of the boreholes and core samples. Surveying will be performed by Weaver Consulting Group. Construction of paths and drill pads will be performed by Sharp STL Service, Inc. under supervision by Feezor Engineering, Inc. Laboratory analyses of the samples will be performed by Eberline Analytical in Oak Ridge, Tennessee. GCPT drilling and logging will be performed by ConeTec and Sonic drilling will be conducted by Frontz Drilling, both of which were the same drilling contractors used for the prior Phase 1 work.

References

EMSI, 2000, Remedial Investigation, West Lake Landfill Operable Unit 1, April 10.

Feezor Engineering, Inc., P.J. Carey & Associates, Engineering Management Support, Inc., and Auxier and Associates, Inc., 2014a, Bridgeton Landfill Thermal Isolation Barrier Investigation Phase 1 Report, Bridgeton, St. Louis County, Missouri, December 19.

Feezor Engineering, Inc., P.J. Carey & Associates, Engineering Management Support, Inc., and Auxier and Associates, Inc., 2014b, Bridgeton Landfill – West Lake Landfill Core Sampling (Phase 1B, 1C, and 2) Work Plan – Revision 1, Bridgeton, St. Louis County, Missouri, January 8.

Feezor Engineering, Inc., 2014c, Bridgeton Landfill / OU-1 Coring (Phase 1B, 1C, and 2) Work Plan – Addendum 1, February 11.

Feezor Engineering, Inc., 2014d, Bridgeton Landfill / OU-1 Coring (Phase 1B, 1C, and 2) Work Plan – Addendum 2, February 27.

Feezor Engineering, Inc., 2013, Bridgeton Landfill – West Lake Landfill Gamma Cone Penetration Test (GCPT) Work Plan Revision 2, Bridgeton, St. Louis County, Missouri, September 27.

McLaren Hart, 1996a, Overland Gamma Survey Report, West Lake Landfill Radiological Areas 1 & 2, April 30.

McLaren Hart, 1996b, Soil Boring/Surface Soil Investigation Report, West Lake Landfill Areas 1 & 2, November 26.

Nuclear Regulatory Commission, 1988, Radioactive Material in the West Lake Landfill, Summary Report, NUREG-1308 Rev. 1, June.

Radiation Management Corporation, 1982, Radiological Survey of the West Lake Landfill, St. Louis County, Missouri, NUREG/CR-2722, May.

U.S. Environmental Protection Agency (EPA), 2015, Letter to Paul V. Rosasco, P.E. (EMSI) from Brad Vann (EPA Region VII) dated March 5, 2015 (Comments on the Bridgeton Landfill Thermal Isolation Barrier Investigation Phase 1 Report),

If you have any questions or desire additional information related to this Work Plan Addendum or any other aspect of the project, please do not hesitate to contact me.

Sincerely,
ENGINEERING MANAGEMENT SUPPORT, Inc.

A handwritten signature in black ink, appearing to read 'Paul V. Rosasco', with a stylized flourish at the end.

Paul V. Rosasco, P.E.

Attachments:

Table 1: Summary of Elevation Data and Anticipated Depth of the Proposed Phase 1D Borings
Figure 1: Proposed Phase 1D Borings in Area 1

Distribution:

Shawn Muenks - Missouri Dept of Natural Resources

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Dale Guariglia – Bryan Cave HRO

John McGahren – Morgan Lewis

Steven Miller - U. S. Department of Energy

Philip Dupre – U.S. Department of Justice

Dan Feezor – Feezor Engineering

Mike Bollenbacher – Auxier & Associates

Table 1: Summary of Elevation Data and Anticipated Depth of the Proposed Phase 1D Borings

| Boring | Northing | Easting | 1971 Elevation | 1975 Elevation | 1979 Design Elevation | 2014 Elevation | Minimum of 1971, 1975, 1979 Elevations | Anticipated Depth of Boring |
|--------|--------------|------------|-------------------|-------------------|--------------------------|-------------------|--|--------------------------------|
| 1D-1 | 1,069,084.94 | 515,745.70 | 457.5 | 454.9 | | 462.2 | 454.9 | 7.3 |
| 1D-2 | 1,068,998.58 | 515,777.22 | 462.1 | 445.3 | | 466.6 | 445.3 | 21.3 |
| 1D-3 | 1,068,972.45 | 515,874.51 | 444.2 | 463.9 | | 471.5 | 444.2 | 27.3 |
| 1D-4 | 1,068,793.50 | 516,091.90 | 434.0 | 449.0 | 467.2 | 496.3 | 434.0 | 62.2 |
| 1D-5 | 1,068,649.79 | 516,038.76 | 431.6 | 438.9 | 457.7 | 486.1 | 431.6 | 54.5 |
| 1D-6 | 1,068,729.80 | 516,151.73 | 431.6 | 447.8 | 458.6 | 510.9 | 431.6 | 79.3 |
| 1D-7 | 1,068,645.80 | 516,152.49 | 441.3 | 437.5 | 451.4 | 511.3 | 437.5 | 73.8 |
| 1D-8 | 1,068,818.90 | 516,241.96 | 431.6 | 456.2 | 460.7 | 516.4 | 431.6 | 84.7 |
| 1D-9 | 1,068,668.89 | 516,214.42 | 440.2 | 438.7 | 450.1 | 519.1 | 438.7 | 80.4 |
| 1D-10 | 1,068,897.82 | 516,307.30 | 431.6 | 464.9 | 463.7 | 503.4 | 431.6 | 71.8 |
| 1D-11 | 1,068,732.16 | 516,318.69 | 431.6 | 439.1 | 449.7 | 521.7 | 431.6 | 90.1 |
| 1D-12 | 1,068,879.49 | 516,446.50 | 431.6 | 444.1 | 445.8 | 505.5 | 431.6 | 73.9 |
| 1D-13 | 1,068,808.45 | 516,404.51 | 431.6 | 443.6 | 450.4 | 519.5 | 431.6 | 87.9 |
| 1D-14 | 1,068,737.78 | 516,389.12 | 440.5 | 439.3 | 447.0 | 521.6 | 439.3 | 82.3 |

Notes:

- 1) The 1971 Elevation was determined from a March 12, 1971 topography developed by Surdex Corporation from historical aerial photogrammetry.
- 2) The 1975 Elevation was determined from an April 6, 1975 topography developed by Surdex Corporation from historical aerial photogrammetry.
- 3) The 1979 Elevation was determined by a surface provided by Aquaterra to represent the bottom of the fill - its methodology of determination is unknown.
- 4) The 2014 Topography was determined from an aerial topography from Cooper Aerial. Date of flyover March 12, 2014.
- 5) Elevations are for the ground surface in units of feet above mean sea level (amsl).
- 6) Boring depths are in feet below ground surface (bgs)

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LEGEND

- PHASE 1D BORING LOCATION
- ELEVATED DOWNHOLE GAMMA READING FROM PREVIOUS STUDY
- NON-ELEVATED DOWNHOLE GAMMA READING FROM PREVIOUS STUDY
- BEDROCK GROUNDWATER WELL
- PROPOSED BORING LOCATION
- LOCATIONS WITH ELEVATED PHASE I GAMMA READINGS AND/OR RADIUM OR THORIUM ABOVE UNRESTRICTED USE LEVELS
- SFS ESTIMATED MINIMUM EXTENT OF RIM
- SFS ESTIMATED EXTENT OF RIM
- SFS ESTIMATED POTENTIAL OUTER EXTENT OF RIM
- FENCE
- 03-20-14 TOPOGRAPHIC CONTOUR
- APPROXIMATE INTERSECTION OF 1971 AND 1975 TOPOGRAPHY
- EDGE OF NORTH QUARRY HIGH WALL
- APPROXIMATE AREA 1 BOUNDARY
- NORTH TOE OF ABOVE GRADE PORTION OF NORTH QUARRY LANDFILL UNIT

NOTES:
x AERIAL TOPOGRAPHY PROVIDED BY COOPER AERIAL SURVEYS CO. AND IS DATED MARCH 20, 2014
x ALL ELEVATIONS ARE ABOVE MEAN SEA LEVEL (AMSL)

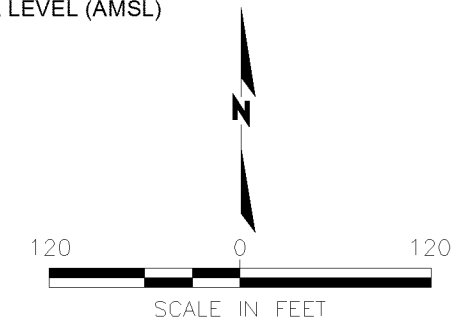


Figure 1
**PROPOSED PHASE 1D BORINGS
IN AREA 1**
West Lake Landfill OU-1
EMSI Engineering Management Support, Inc.